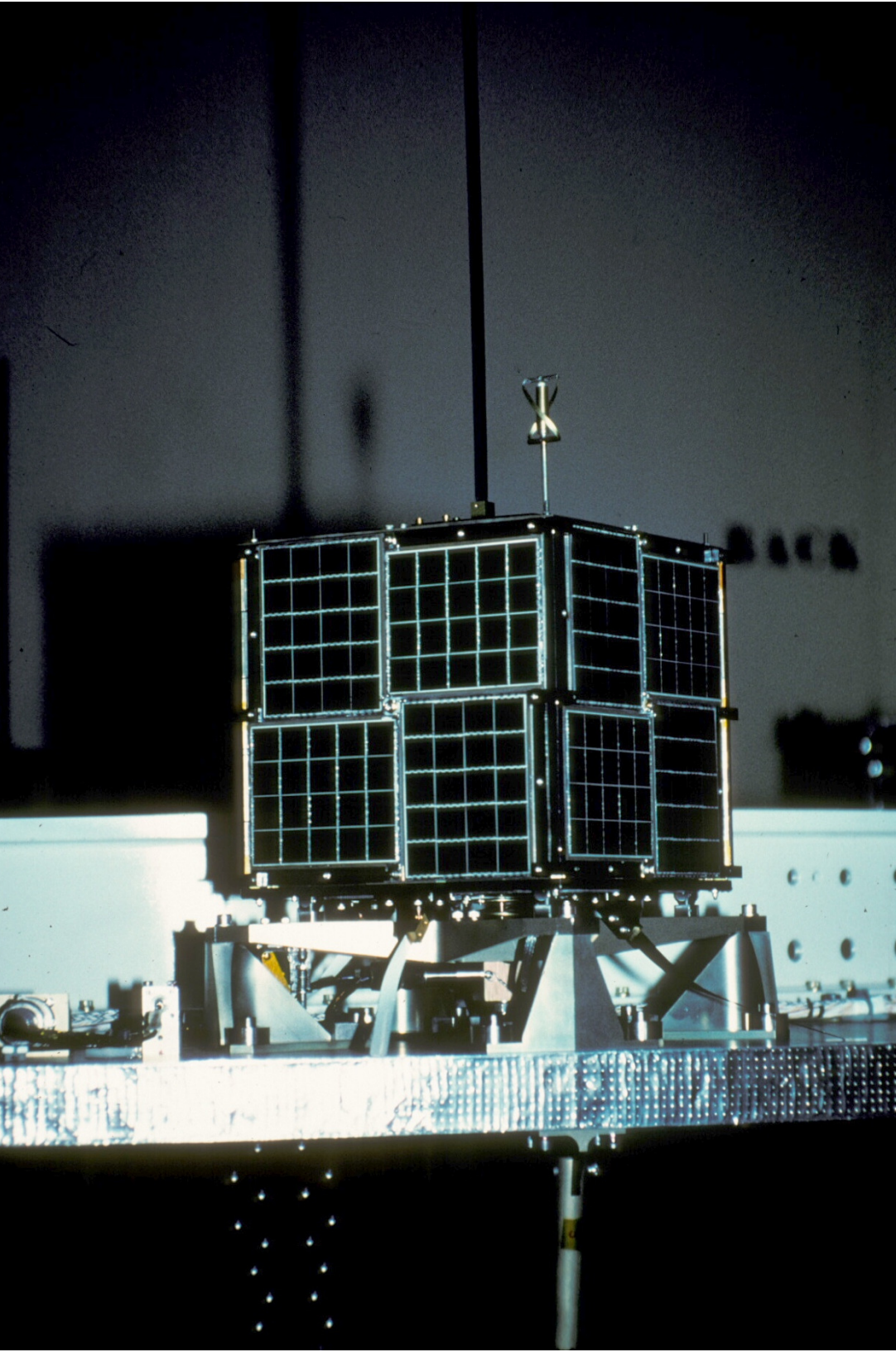




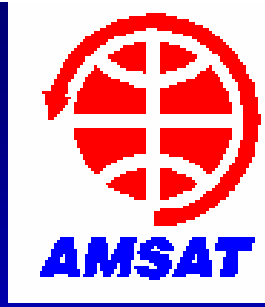
AO-16 (PACSAT) Update

Symposium 2008
Atlanta

Mark Hammond
N8MH

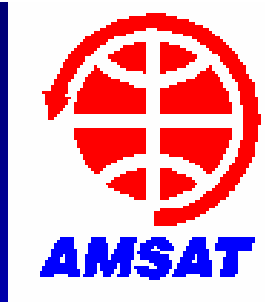


Quick Overview



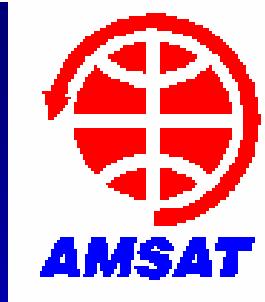
- Brief history of AO-16
- Current Satellite Status
- Outlook for AO-16

A Brief History of AO-16 (PACSAT)



- AO-16, DO-17, WO-18, and LO-19 launched on January 22, 1990
- AO-16 (and WO-18/LO-19)
 - Digital Store and Forward packet satellites
- Nearly 17 years of continuous operation

A Brief History of AO-16 (PACSAT)



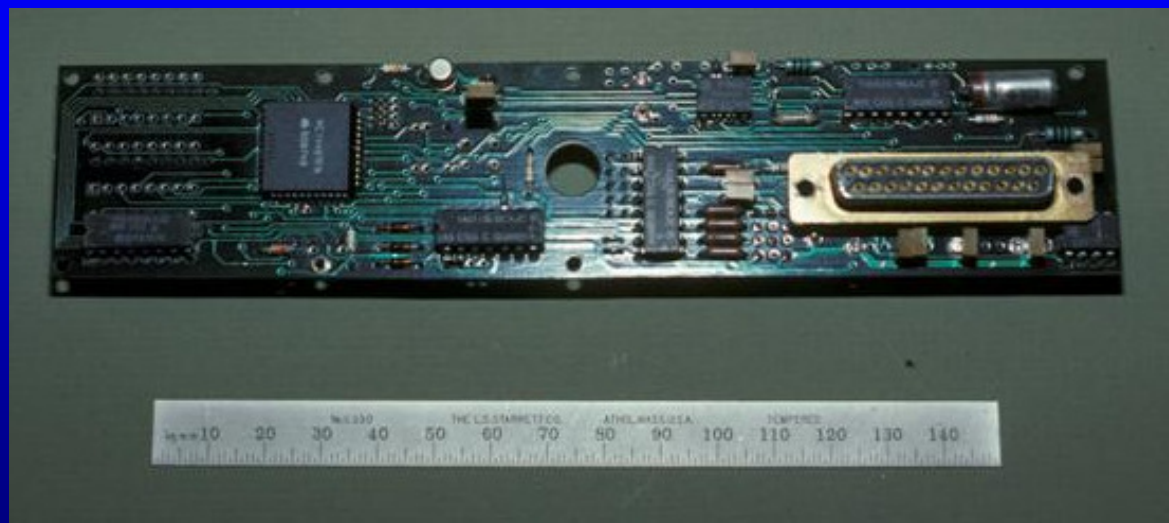
- AO-16 reported silent in May 2007
~2700 days since its last software reload!
- In November 2007 AO-16 was commanded back ON
- Simple memory testing suggests random errors while writing to EDAC RAM



Teaching an Old Bird a New Trick



- Jim White WD0E recalls a special pass-through mode
- Tom Clark K3IO's AART (asynchronous addressable receiver/transmitter) interface

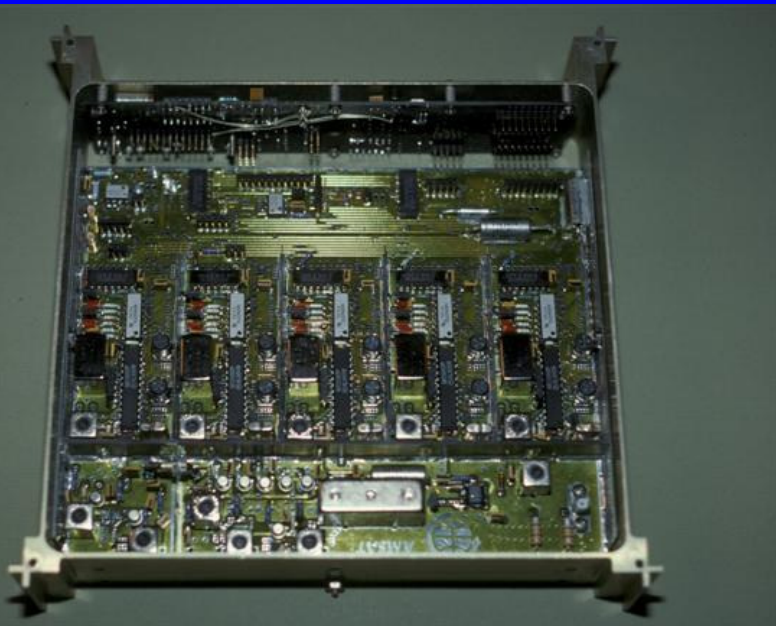


Teaching an Old Bird a New Trick

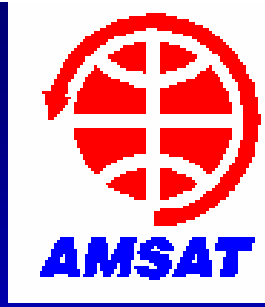


- Provision for connecting receiver output directly to PSK transmitter via commands

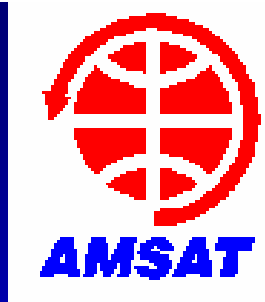
2M FM receiver (any of four receivers) → 70 cm PSK transmitter (only works with TX A)



Teaching an Old Bird a New Trick

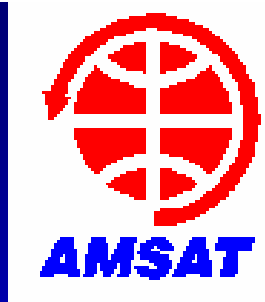


- Result is a new mode, V-FM/U-DSB
- Conversion of a non-functioning digital bird into a voice bird
- Works well for voice operations (DSB downlink easy to hear)



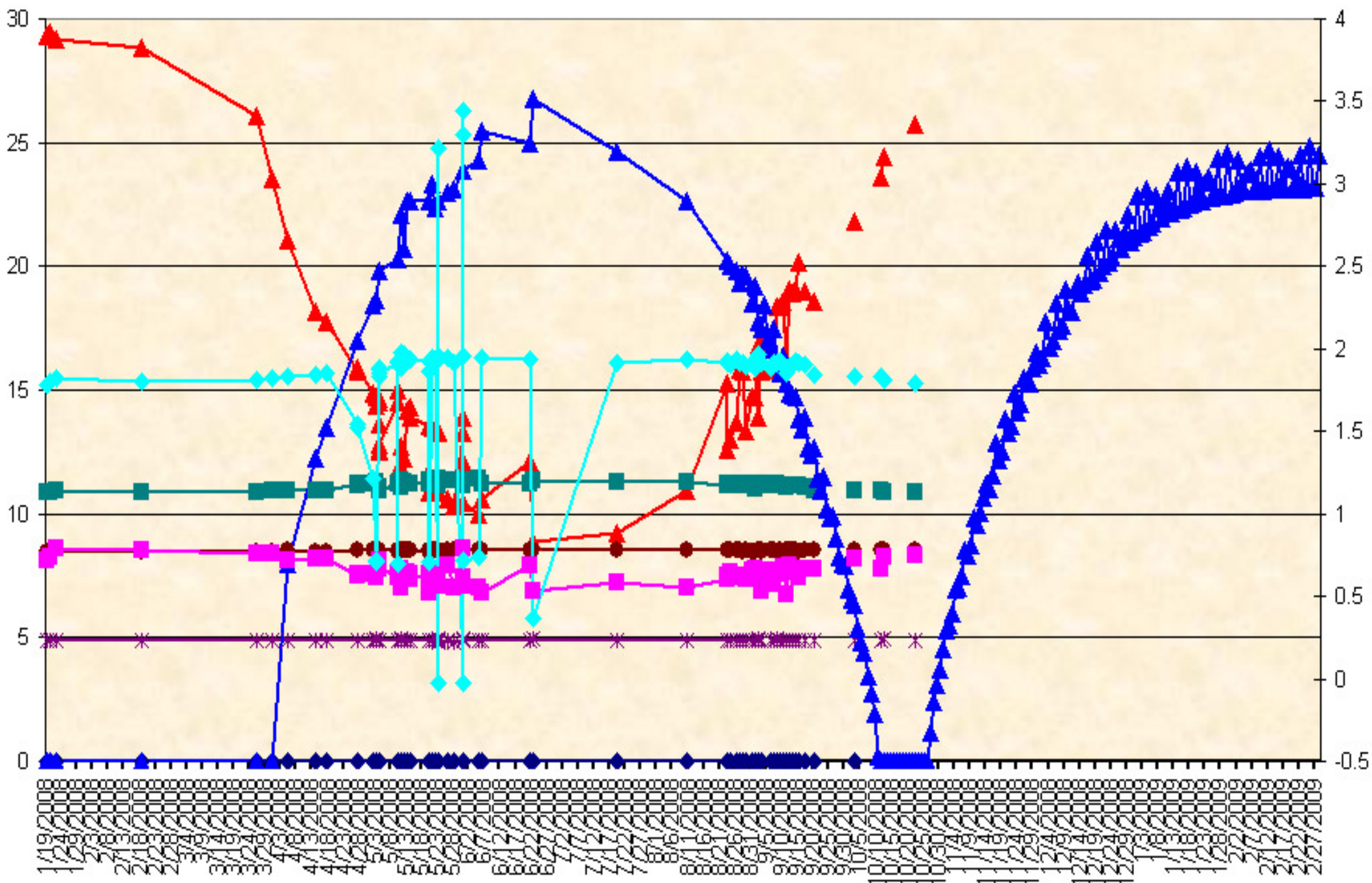
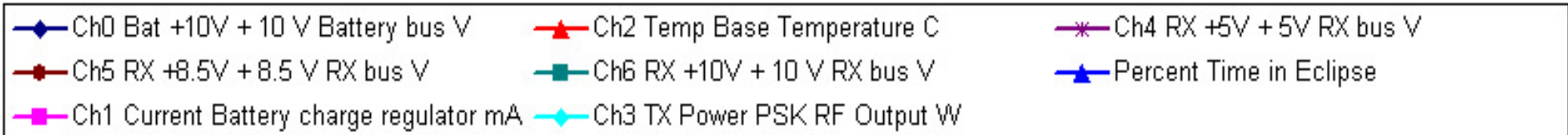
AO-16 Status

- Began voice operations January 20, 2008 (two days before 18th birthday!!)
- Had been in continuous illumination (no eclipse periods) since recovery in November 2007
- Eclipse periods began around March 30, 2008

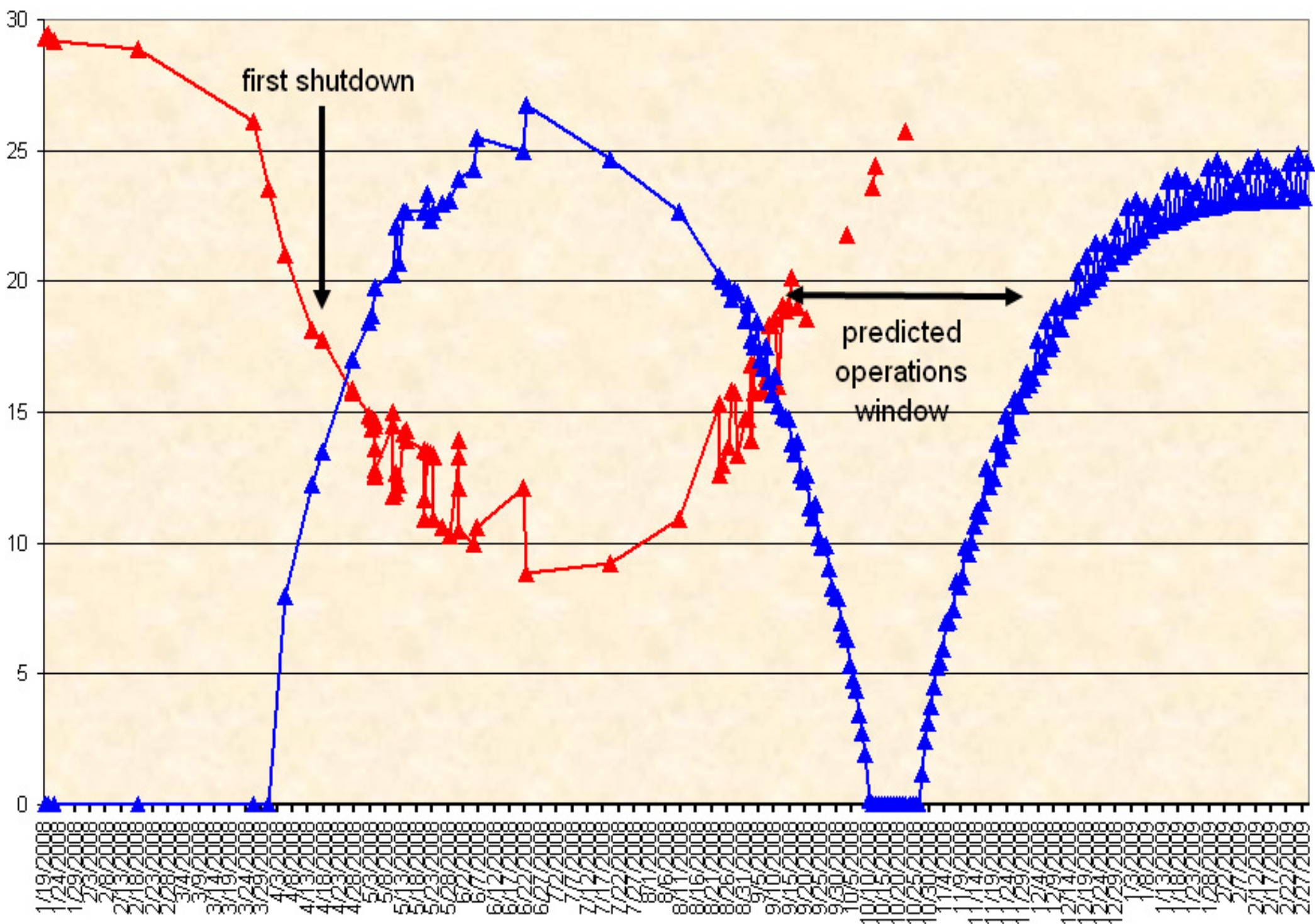


AO-16 Current Status

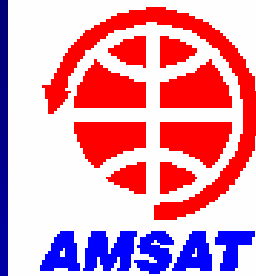
- On April 17, 2008 reported to be silent
- Was difficult to keep AO-16 transmitter turned ON
- Telemetry suggests spacecraft temperature may be culprit (rather than batteries and power budget)



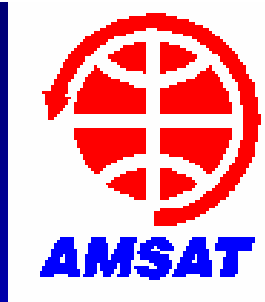
Ch2 Temp Base Temperature C Percent Time in Eclipse



SPECULATION: Possible Causes of AO-16 Shutdowns



- Unlikely to be power budget
 - “flea power” didn’t stop shutdowns
- Probably temperature related
 - Hardware “watch dog” timer circuit
 - Component value(s) change with temperature
- WO-18 and watch dog timer



The Future of AO-16

- Current full illumination (October 2008) ends in early November
- Predict temps to DROP and shutdowns to return in mid-November
- After that, no full illumination predicted for at least several years
- Expect AO-16 operations to be intermittent at best
- Possible changes in component values might improve situation—or make it worse!

Additional Details



AO-16

A Second Life for AO-16: Crash – Recovery – Rebirth

Mark Hammond, N8MH, n8mh@amsat.org

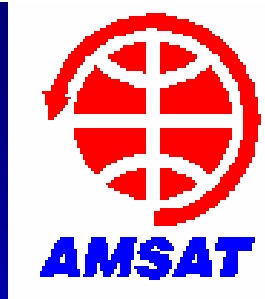
Jim White, WD0E, wd0e@amsat.org

and Bruce Rahn, WB9ANQ, wb9anq@amsat.org

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Acknowledgments

AO-16

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Paul Williamson, KB5MU

Russ Platt, WJ9F

Tom Clark, K3IO

WO-18

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The entire Microsat team